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Special Programs

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Special Programs

AICHE Student Chapter named Outstanding Chapter at the November 2008 AICHE Centennial Meeting

The University of Kentucky's American Institute of Chemical Engineers (AICHE) Student Chapter was named an outstanding chapter for the 26th consecutive year. Only about ten percent of student chapters receive this distinction annually. The students presented a workshop on leadership development and fundraising at the Centennial meeting in Philadelphia, PA. The workshop was prepared and presented by Lauren Rosenbeck, Alex Montague, Aaron Hickey, and Don Johnson.

The UK chapter also participated in the AICHE Computing and Systems Technology Division sponsored video contest. The contest required students to submit a video of no more than seven minutes demonstrating their creativity and vision about the future of chemical engineering. The University of Kentucky received $200 for the effort and the video was showcased at the Annual Student Conference Bash. The video was created by Lauren Rosenbeck, Alex Montague, Don Johnson, Stephen Batt, Corey Barnett, and Joel Vice.

Several students also participated in the Undergraduate Student Poster Presentations. Alex Montague presented "Poly-Acrylic Acid Functionalized Membrane for Iron Immobilization and Fenton Reaction." Juan Carlos Cordova presented "Biodegradable Hydrogel Systems on Orthopedic Implants for Growth Plate Regeneration." Finally, Don Johnson presented his poster "Synthesis and Characterization of Temperature Responsive Hydrogel Nanocomposites."

BIG BLUE V

"BIG BLUE V" is a workforce development project currently in its fifth year at the University of Kentucky (UK).This unique multi-university, multidisciplinary project is providing students with opportunities to learn about and to prepare for aerospace engineering careers. BIG BLUE is a comprehensive aerospace project experience to design, build and conduct a complex, high altitude experiment to verify the feasibility of inflatable-wing technology for Mars exploration. To date, three successful high-altitude experiments have been completed, along with participation in a student unmanned aerial vehicle competition. From the workforce development perspective, students involved in BIG BLUE join the aerospace workforce while participating in the challenging research-oriented project, which influences their decision to choose and pursue an aerospace career."

Design/Build/Fly

The Cessna/ONR Student Design/Build/Fly contest was founded as a "hands on" student experience to increase their knowledge and ability to work in an industry environment after graduation. The organizers had noticed that many of the new graduates entering their companies had no practical experience in design. As their first assignment with a large aerospace company was typically a small part of the overall design, many of them worked for several years before having the opportunity to see the "big picture" view of how different design decisions interact.

With that in mind the first and foremost objective of the competition has been to become and to remain an educational tool.

The goal of this project is to design, build, and fly an electric R/C airplane to achieve a specified objective (range, payload, speed, etc). The winner is determined by the best combination of written report and flight performance, determined at the competition flyoff.

In order to keep the competition fresh, students are challenged with new design objectives every year. This also requires a fresh look by the organizing committee at writing the rules, with continued attempts to learn from the previous years' experience.

The UK Design/Build/Fly team completed the last day of competition on April 19, 2009 by getting to fly with the plane. The first flight, mission 1, was a success. A pilot from another team flew the plane the first time to test it. UK then repeated mission 1 allowing the team pilot, Brady Doepke, to fly the plane. This flight was also successful.

The second mission was 4 laps with a full water bottle which added roughly 10 lbs to the plane. 3.5 laps were completed before power issues prevented the plane from continuing. Fortunately, the plane was still mostly intact after the impact.

Due to the damage that was done to the plane and the power issues, the team decided to stop with mission 2 and be able to arrive home with a plane. The team felt the competition was a success. They were in the top 50% of the competition. There were a large number of teams that weren't able to qualify due to the inspections. UK's team goal for this first venture in the AIAA DBF competition was to qualify and successfully complete a mission, which they achieved.

UK Team Performs CT Scans of Ancient Papyrus Scrolls

by Kathy Logsdon

The Enhanced Digital Unwrapping for Conservation & Exporation (EDUCE) project began approximately five years ago. Dr. Brent Seales, Computer Science professor, began using X-ray to obtain hidden information from artifacts non-destructively. During the summer of 2008, the members of EDUCE digitalized the oldest copy of the Iliad and put it online. Seales' trip to Venice, Italy to digitally "unroll" the Iliad led to interest in this project and connected him with people and resources, which helped gain access to the papyrus scrolls.

The scrolls were buried in a volcanic eruption of Italy's Mount Vesuvius in the resort town of Herculaneum about 2,000 years ago. The lava flows incinerated most of the scrolls from the town's private collection and the intense heat carbonized the scrolls. About 2,000 scrolls were dug up, one layer at a time. The King of Naples received four of the remaining scrolls as a gift and gave them to Napoleon. Napoleon sent them to the National Institute of France. Two of the scrolls have been opened or lost; the other two are the only scrolls no longer housed in Italy.

The EDUCE team, a project of the University of Kentucky's Center for Visualization, arrived July 6, 2009 at the Institut de France. Matt Field and Ryan Baumann, Master level students, were part of the five member team who travelled to Paris. Matt went for the first half of the trip and Ryan went for the second half. The remaining three members who travelled to Paris included Dr. Seales, IT support and a document photographer.

Last winter, Claire O'Toole (an undergraduate student) took a class about digitalization of historical books under Dr. Seales and became involved in the EDUCE project. The scrolls in question, which are now located in the French National Institute in Paris, have never before been opened or read. O'Toole said the goal of the project is to continue developing new technology to provide a safe way to decipher and preserve more scrolls from Herculaneum.

After arriving in Paris, the team mounted the scroll in a special container to support it during scanning inside the SkyScan 1173. With protection from this custom mounting container, the scroll can stand on end while the scanner rotates it in a gentle pirouette. The team setup to begin acquiring scans at the best resolution and with the best possible contrast, revealing the internal layers and giving hope to the goal of eventually "virtually unrolling" the layers to read the text. They took images of the scrolls in the Musée du Louvre in Paris where they took Computed tomography or CT scans of the scrolls.

CT scanning combines special X-ray equipment with sophisticated computers to produce multiple images or pictures of the inside of an object. These cross-sectional images of the area being studied can then be examined on a computer monitor or printed. Digital geometry processing is used to generate a three-dimensional image of the inside of an object from a large series of two-dimensional X-ray images taken around a single axis of rotation. EDUCE tested the effects of 3D X-ray scanning of the two carbonized papyrus scrolls. The internal structure in 3D was clearly visible without damaging the scrolls.

The research environment came together from three different countries, and includes twelve terabytes of storage capacity, the SkyScan 1173 micro-CT scanner, and several computers to drive the EDUCE team's software. The portable CT scanner, SkyScan is a loan from Bio Labs in Belgium and weighs between 600-700 lbs.

In addition to the successful preliminary scans, the team was also honored by a visit from M. Jean Leclant, Secrétaire Perpétuel de l'Académie

Fabienne Queyroux, Conservator, places scroll into the scanner des Inscriptions et Belles-Lettres. It was his personal initiative and approval that made the team's visit for this work possible. He and his wife spent time with the EDUCE team discussing the project, reviewing results and the research plan, and expressing support and enthusiasm for the work.

The next step was the systematic and time-consuming process of scanning every millimeter of both scrolls (PHerc.Paris 3 and PHerc.Paris 4) at the highest resolution possible. These scans, once captured and safely stored in the redundant data storage system, gave the team enormous options for analysis, including the search for visible text. For now, the internal structure in 3D is clearly visible.

As the team began examining the scans they saw an internal structure that is chaotic, far from the regular spirals one might expect from a scroll. Given the intense heat and pressure of the Vesuvius explosion, followed by two thousand years of survival, perhaps the miracle is that there is anything left from the Herculaneum library.

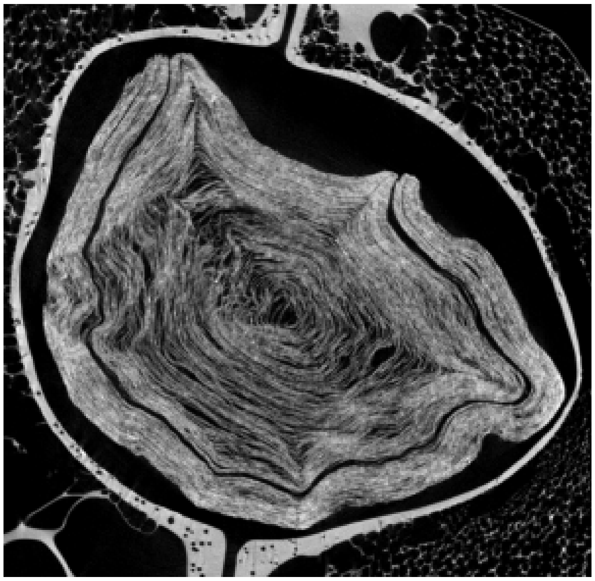
After many hours of CT scanning with the SkyScan 1173, complete data sets were compiled for both Herculaneum scrolls at the Institut de France. From this data the entire internal structure of the papyrus can be seen: folds, breaks, creases. This exceptional look into the interior of the rolls was captured in a non-destructive way, leaving the rolls undisturbed for future analysis.

These scans helped acquire a wealth of data. For example, each x-ray projection is a 16 bit image at 4000 x 2000 resolution. Computed Tomography requires projections of at least 180 degrees or 360 degrees for a cleaner reconstruction. By collecting an x-ray projection every 0.2 degrees, the data set ends up with 1800 projections over a 360-degree rotation. This is roughly 18 MB of data per projection times 1800 projections which covers one section of the scroll. The scrolls were divided into five zones to capture data over the whole length. Five zones, 1800 projections per zone, at 18 MB per projection gives about 170GB of raw data. This is the input to the reconstruction algorithm. Once reconstruction takes place, the 3D slices are generated: 8000 slices, each 16-bit at 4000 × 4000 resolution. This yields another 250GB of data for a total of 420GB. This amount of data is for one scan. The team has captured several scans of each scroll under varying parameters.

O'Toole said the group took computer images of the scrolls, adjusted the light, and set a batch of projects to compile in the hope of finding text or older copies of artifacts they know existed years ago. People have tried for centuries to open them, but the scrolls kept disintegrating. The old ink on the scrolls contains metal. The team was concerned about the ink used in the scrolls. If the ink was carbon-based, it might not have been possible to visually separate the carbon ink from the carbonized papyrus. In other words, the scrolls could be unreadable. But since the original writer used a metal-based ink, a readable computer image could be obtained more easily.

The CT images were sent back to the Visualization Center electronically. O'Toole and Kyle Kolpeck are undergraduates who were hired to do the work of pulling everything apart for viewing and analysis of the computer images. Unfortunately, the group only has the software license until November 2, and then they will pull everything apart and see what data is available.

The scanning itself is just the first step; once the data is liberated from the physical handing of the scrolls themselves, it can take on a life of its own as teams push forward to analyze it and understand its significance. This kind of "virtual analysis" is a remarkable step forward, lessening the need to handle the scrolls and opening up the possibility for analysis to a wider community.



Scan of Herculaneum Scroll, Pherc Paris 3

With concentration first and foremost on the safety and careful handling of the scrolls, the work has been methodical and slow. The structure of the slices clearly shows that the segmentation of the visible layers into meaningful, flattened regions will be a very big challenge. The team will be working to "digitally unwrap" promising sections in the search for a way to tease out an image of the writing itself, which is the ultimate goal. It is impossible to tell at this stage if this will be successful.

They have considered using an MRI scan, but it is not manageable due to size. They haven't done anything with MRI scanning up to this point.

"If we have positive results from any of these tests, I think it will open doors for us," stated Field. He said they may go back to reimage in a year or two.

UK Solar Car

By: Steven Hughes

Qualified. It's nice to know you have what it takes. For the second summer in a row, the University of Kentucky Solar Car Team's Gato del Sol III qualified for racing. As a driver on the race, I felt like my duties were already completed. After passing egress testing and zooming around the figure-8 a few times, qualification seemed to me like the end.

Last summer, our team had qualified for the North American Solar Challenge, a 2400-mile cross-country race from Dallas, Texas, to Calgary, Alberta. We ended up finishing 11th in that race, taking home the pride of completing our first race ever with our third-generation sun-powered vehicle.

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This summer, at the Formula Sun Grand Prix track race in Cresson, TX, the atmosphere was different. Race experience and a qualified, reliable car were no longer just aspirations. We knew that we had what it takes. Qualification was an expectation, and finishing in the top three had become our new aspiration.

Day 1 of racing, Wednesday, did little to brighten our spirits. Waking up to see a sky full of clouds and hearing reports of thunderstorms in the area, most of us had our doubts as to how this race would turn out. We were already exhausted after a couple of late nights spent trying to get the motor controller functioning properly.

At the end of the day, exhaustion and rain had transformed into energy and sunny skies. Despite having slow lap times, we finished that first day in 4th place, thanks to a highly reliable car. Wednesday's 10 hours of racing saw only three 5-minute pit stops by our team, and all the hard work from the previous night had paid off to the tune of 100 percent mechanical and electrical reliability.

Day 2 of racing, Thursday, wasn't even partly cloudy. The only thing that seemed to outshine the sun was the performance of our car and pit crew. The car only had to spend 10 minutes of total time off the track that day, driver changes and all, which turned out to be a race record. While other teams, including first-place Minnesota, were having tire blowouts or battery issues, our car was faithfully cruising around the track without a problem.

Thursday's performance bumped our team up to an unofficial 2nd place. Needless to say, we were all excited and proud of our success so far; but there was still one day left. There were still 10 more hours of racing left to prove that our team was among the elite.

Day 3 of racing, Friday, couldn't have been longer. Once again, our car was proceeding around the track without a problem. Things were slowly intensifying and picking up speed as all the teams moved towards one simple game plan for the afternoon—to squeeze out every last bit of energy from their batteries and tally up as many laps as possible.

Our team was no exception. We recorded very fast lap times most of the day, often averaging more than 40mph around the 1.7-mile track. With about an hour left in the race, and a 2nd-place finish nearly guaranteed, the team had already begun to celebrate. Gato III was still flying around the track when some bad news came in from the telemetry crew. Apparently, one of the car's 28 battery modules had significantly dropped in voltage. If it continued to decrease, the battery protection system would soon kick in and trigger an immediate shut down of the car.

The driver was told to slow down in order to let the battery module charge back up, but it already was too late. During what was supposed to be the final lap of the race, the car shut off on an uphill section of the farthest bend of the track. It would not start back up again; but we were determined to get the car across the finish line without having to call in the tow truck.

Shortly thereafter, and in nothing less than epic fashion, we found ourselves in the middle of what turned out to be quite a nice cardio workout. Much to the entertainment of the other teams, we were able to push and pull Gato del Sol III for about a mile around the last half of the track, all the way back to the finish line, where we were greeted with smiles and congratulations for a dramatic 2nd-place finish.

As I recovered my breath, I took a second to think about what we had accomplished. Just a year ago, our team was essentially a first-timer at solar racing, happy to be qualified and squeezing out an 11th place finish in the North American Solar Challenge. This summer, by means of the same car that had limped those 2400 miles over ten days last summer, our revamped team was taking the Formula Sun Grand Prix 2nd-place trophy back with us to the bluegrass.

In light of our success at FSGP 2009, it's hard not to be excited about UK's future in solar car racing. All thoughts are now turned towards Gato del Sol IV and NASC 2010. Once again, our goal is to be one of the top three finishers, but this time, the competition will be tougher. Up until now, our team has been playing catch-up to some of the more experienced American teams such as Michigan and Minnesota. Now we too are on the frontier, pushing research and design of solar cars to a new level. When completed, Gato IV will be in the company of the most advanced solar cars in the world.

The first new addition is an improved solar cell array. Previously, the team has employed silicon solar cells in array construction. Although relatively inexpensive and easy to work with, silicon cells have a maximum operating efficiency of only 20 percent. The new array will be composed of over 2000 triple-junction gallium-arsenide cells, each operating at upwards of 28 percent efficiency.

Another improvement takes the form of a lighter, more aerodynamic shell. Gato III's shell was made of foam and fiberglass and the new shell will be a composite structure that combines a lightweight Nomex honeycomb core with a rigid carbon-fiber outer layer. Aerodynamic drag has also been greatly reduced by altering the shape of the car (i.e. moving the cockpit back) in order to increase laminar flow.

Other improvements include the addition of custom 16-inch wheels,

UK Solar Car

a more energy-dense lithium-based battery pack, a Tritium WaveSculptor motor controller, and a charge balancing system that ensures maximum battery charge/discharge consistency. As a finishing touch, the steering wheel will contain some of the driver controls and an LCD to depict speed, array power output, and some other data.

Despite the many improvements, quite a few aspects of Gato del Sol IV will remain largely unchanged from Gato III. Of course, the three-wheeled, one-seat, no-doors, and airfoil-shaped design is here to stay. Other components, including the nine-horsepower DC brushless motor, aluminum chassis, battery protection system, and CAN network have seen few modifications. The maximum power point trackers (MPPTs), which govern the solar array, will also be roughly the same design as before, although they will require some adjustments to accommodate the new gallium-arsenide cells.

Aside from design and manufacturing, the business team has been hard at work finding sponsors and raising money to fund the construction of the new car. The total expense of Gato del Sol IV is estimated to be about $230,000.

All in all , building a functional solar car is very much a team effort. Many people question whether the finished product is worth all the time and money that is put into it. Our mission is to design, finance, build, and race solar powered cars. However, the end goal of our team is much more significant:

Solar power is widely regarded as the best potential source of renewable energy. It is also extremely underutilized. Although photovoltaic cells can be pricey, the materials to manufacture them are plenty, and the theoretical uses of solar energy are virtually endless. More research, discovery, and experimenting are the only things that stand in the way of solar energy becoming a primary source of energy worldwide.

As students at the University of Kentucky, we already have many great resources at our disposal; but nothing provides inspiration and hands-on experience like the solar car team. With 35 members and a world of potential in front of us, the University of Kentucky Solar Car Team is ready to push research and design to greater heights than ever—and I know that we are more than qualified to do it.

UK S•KY BLUE House Took Ninth Place in the U.S. Department of Energy Solar Decathlon

For three weeks in October 2009, the U.S. Department of Energy hosted the Solar Decathlon—a competition in which 20 teams of college and university students competed to design, build, and operate the most attractive, effective, and energy-efficient solar-powered house. The Solar Decathlon is also an event to which the public is invited to observe the powerful combination of solar energy, energy efficiency, and the best in home design. Exact dates of the 2009 event were:

- Oct. 8-16—Teams compete in 10 contests
- Oct. 9-13—Houses are open to the public
- Oct. 15-18—Houses are open to the public
- Oct. 19-21—Teams disassemble their houses.

The Solar Decathlon consisted of three major phases:

- Building: This is where most of the work—and the learning—happens. In addition to designing houses that use innovative, high-tech elements in ingenious ways, students have to raise funds, communicate team activities, collect supplies, and work with contractors. Although the Solar Decathlon competition receives the most attention, it's the hard work that students put in during the building phase that makes or breaks a team.
- Moving to the Solar Village: When it's time for the Solar Decathlon, the teams transport their houses to the National Mall in Washington, D.C., and rebuild them on site.
- Competing: During the competition itself, the teams receive points for their performance in 10 contests and open their homes to the public.

The Solar Decathlon has several goals:

1. To educate the student participants—the "Decathletes"—about the benefits of energy efficiency, renewable energy and green building technologies. As the next generation of engineers, architects, builders, and communicators, the Decathletes will be able to use this knowledge in their studies and their future careers.
2. To raise awareness among the general public about renewable energy and energy efficiency, and how solar energy technologies can reduce energy usage.
3. To help solar energy technologies enter the marketplace faster. This competition encourages the research and development of energy efficiency and energy production technologies.
4. To foster collaboration among students from different academic disciplines—including engineering and architecture students, who rarely work together until they enter the workplace.
5. To promote an integrated or "whole building design" approach to new construction. This approach differs from the traditional design/build process because the design team considers the interactions of all building components and systems to create a more comfortable building, save energy, and reduce environmental impact.
6. To demonstrate to the public the potential of *Zero Energy Homes*, which produce as much energy from

S•KY BLUE House

renewable sources, such as the sun and wind, as they consume. Even though the home might be connected to a utility grid, it has net zero energy consumption from the utility provider.

University of Kentucky's S•KY BLUE House descended on the U.S. Department of Energy (DOE) Solar Decathlon competition at the National Mall in Washington, D.C. where it joined 19 other schools from across North America and Europe in the prestigious competition that demonstrates homes powered entirely by the sun do not have to sacrifice modern comforts and appealing features.

Since early 2008, UK's team worked hard at designing and constructing the S•KY BLUE House. The 20 teams chosen to compete were asked to create and send an 800-square-foot or less solar-powered house, built by students on their home campus, to the National Mall. Each team's house was evaluated in the competition in 10 specific areas: architecture, engineering, market viability, lighting design, communications, comfort, appliances, hot water, energy balance and home entertainment.

UK's team members not only designed their house, but fabricated many of its custom elements including the building's structure, which presented students with the unique opportunity to work alongside metal fabricators at the AMRL (Agriculture Machinery Research Laboratory).

The UK design presents an optimized living and learning environment that engages the landscape through an integrated design approach that demonstrates a range of site-flexible and contextual solutions for living under the sun today. The house makes strong reference to Kentucky's passive architectural roots and integrates forward-thinking innovations into a design based upon an open and porous loft concept anchored by the home's hearth, the kitchen core, and a series of outdoor spaces that envelope the house. A breezeway design blends the beauty, simplicity and passivity of various elements of Kentucky vernacular architecture with modern elements ranging from its furniture to Shaker-style built-in cabinetry, wall-integrated folding tables and chairs to active energy-efficient systems and technologies including an LED illuminated perforated cladding system.

The S•KY BLUE House structure is designed to allow for very quick setup and occupancy. Several unique features include: rainwater harvesting systems, fixed and single-axis tracking arrays, PV cooling, electronically tintable glass in non-shaded areas, super high-efficient appliances, a reverse cycle heat pump, demand controlled ventilation for indoor air quality control, and an Automatic Weather Adaptive Response

S•KY BLUE House

Energy (AWARE) control system, which optimizes the energy flows in the house based upon zip-code-specific weather forecasts.

The University of Kentucky S•KY BLUE solar house team is an interdisciplinary group comprised of students, faculty and staff from six colleges and 16 centers and departments within UK. The team has been led by two principal investigators, Donald Colliver, professor of biosystems and agricultural engineering at the College of Agriculture, and Gregory Luhan, associate dean for research at the College of Design, as well as faculty from the College of Communications and Information Studies and College of Engineering.

The UK S•KY BLUE House took ninth place overall in the competition.

After the competition, the UK S•KY BLUE House returned to the Commonwealth to be exhibited at the 2010 FEI World Equestrian Games, scheduled to begin Sept. 25, 2010, in Lexington, Ky. The house will serve as the Visitor's Center and the entry threshold to the Kentucky Experience exhibitions at the events.

Weightless Wildcats

The University of Kentucky Weightless Wildcats is an independent student organization that does research as part of NASA's Microgravity University Program. This program allows student groups the opportunity to test various scientific experiments in a reduced gravity environment. This year, the Weightless Wildcats are examining the movement of air bubbles within syringes in zero gravity. Specifically, we are testing specialized 'dual-piston' syringes. These syringes are made with two plungers, one located inside the other. The first plunger is attached to a mesh sieve that, when depressed, uses the surface tension of any air bubbles to push them to the top of the syringe. The second plunger is used to eject the air bubble and then to inject the fluid.

The purpose of this experiment is to test the effectiveness of the dual-piston syringes in removing air bubbles from the syringe. This is necessary so that astronauts can inject themselves with medication in outer space without the danger of injecting air bubbles into their systems, which can prove fatal. We are testing our experiment aboard the Weightless Wonder, a specialized Boeing 727 (Formerly known by its affectionate nickname, the 'Vomit Comet'). The Weightless Wonder flies in parabolic curves to simulate zero gravity conditions.

NASA's Microgravity University promotes the combination and cooperation of many disciplines of engineering; also known as systems engineering. UK's Weightless Wildcats are comprised of Mechanical, Chemical, Electrical and Computer Engineering students. The Weightless Wildcats travelled to the Johnson Space Center for the Microgravity University program from April 8th - 17th, 2010.